AUTOMATION AND MECHANIZATION OF PRODUCTION

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INCREASING THE ACCURACY OF BATCHING WEIGHING HOPPERS AND ELIMINATING ADHESION OF MATERIALS TO THE WORKING SURFACES OF PROCESS EQUIPMENT

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It was shown that weighing hopper batching equipment with antiadhesive lining plates not only increases the batching accuracy and output of the equipment but also increases its trouble-free operation.

To ensure the required quality of the finished product at enterprises in the construction materials industry, great importance is attributed to measures that improve the accuracy of batching raw materials and fillers. However, in operating with wet materials, they intensively adhere to the working surfaces of the weighing hopper batchers, which interferes in fulfillment of its functions of an accurate measuring instrument.

To prevent adhesion, many companies use electric vibrators, which vibrate the metal walls of the hoppers. As experience has shown, the effectiveness of such vibrators is extremely low because it is difficult to subject the adhering materials to vibration cleaning. The opposite effect of thickening and even greater growth of the layer of raw material stuck to the hopper walls frequently takes place.

Hydrophobization with polymeric antiadhesive lining plates (PALP) of different execution is currently the most effective means of controlling adhesion of various raw materials to the working surfaces of process equipment [1 – 3].

Basic performance characteristics of palp supplied by As-Tik KP Ltd.

Contact angle of wetting, deg	85 – 90
Friction coefficient:	
on steel	0.10 – 0.15
on raw materials	0.35 – 0.45
Wear resistance, rel. units:	
PALP OE (ordinary execution)	400 – 500
PALP IWIS (increased wear resistance and impact strength)	200
PALP HWI (high wear resistance and impact strength)	100

PALP OE were introduced and are being effectively used at Voronezh Ceramics Factory PCF Co. on the working surfaces of three weighing hopper batchers (one on a weighing truck, two stationary); six hoppers with a volume capacity of 20 m^3 filled according to Sakmi plans (Italy); two domestic hoppers for clay.

As a result of the measures instituted on lining the working surfaces of the hoppers, the materials did not stick to the walls of the hoppers (Fig. 1), the vibrators were removed, manual labor used in cleaning was eliminated, the batching accuracy improved, and maintenance of the hoppers was eliminated (the use of vibrators and their impact actions on the walls destroyed the walls and welds).

The most frequently used version of attaching PALP to the walls of process equipment is shown in Fig. 2.

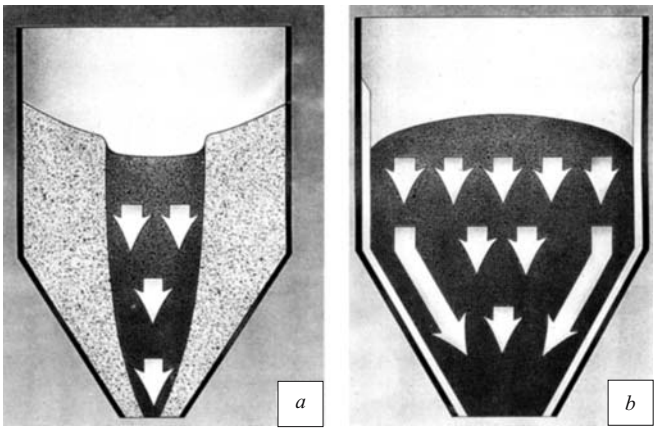

Fig. 1. Movement of material along the walls of an unlined (*a*) and PALP-lined hopper (*b*).

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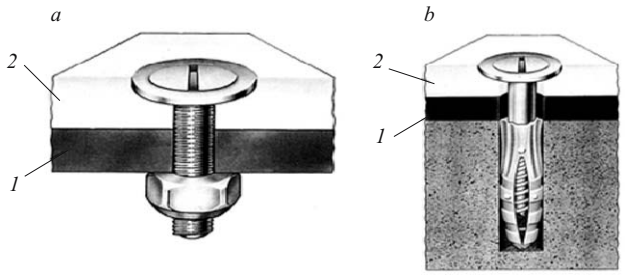

Fig. 2. Diagrams of attachment of PALP to protected working surfaces of equipment: *a*) metal ware flush; *b*) same with expansion bolt; *1*) wall of working equipment; *2*) PALP.

PALP 6 mm thick were installed in a conical hopper (input opening diameter of 1100 m, output opening diameter of 300 mm, height of 1400 mm) for raw material from the weighing truck of a glass-melting furnace. The material charged was a mixture of sand, boric acid, barium carbonate, and kaolin with an overall moisture content of 4 – 9% and granules 1 – 3 mm in size. The working temperature ranges were 5 – 20°C.

Experience in operating the hopper with and without PALP showed:

the idle times of the metal hopper for stripping were 2 – 3 h a week (one worker was required for cleaning); due to inefficient vibrator operation, it frequently had to be replaced (2 units a year) and the hopper had to be repaired (up to 3 a year);

the hopper equipped with PALP is operating without idle times without material adhering to its walls and with no vibrator;

during operation, approximately 1200 control weighings were performed — the total mass of the rack weighed was approximately 660 tons (for a rack weight of 550 kg and up to 30 weighings a day);

no wear was observed in the plates during use of PALP and on visual inspection.

A similar picture was also observed in the hopper for inert raw material, a mixture of sand, cullet of heat-treated materials, and dolomite with a 4 – 9% moisture content. The working temperature range was from + 10 to – 10°C. The trapezoidal hopper measured 2000 × 2000 mm at the top and 400 × 400 mm at the bottom and was 1600 mm high. The transfer unit was a vibrating extractor 1800 mm long and 450 mm wide. The volume of the transferred material was of the order of 84 tons/day. Approximately 7560 tons of material was transferred during operation of a hopper with and without PALP. The idle times of the hopper without PALP were 4 – 5 h a week (cleaning the hopper, replacing its walls and vibrator), and two workers did the cleaning. The hopper with PALP operates without down times and adhesion of materials with no vibrator.

Approximately 300 tons of material (sand, clay, dolomite) passes in the eight stationary hoppers each day. Approximately 80,000 tons of material was transferred during operation (approximately 9 months). No deformations or wear of the plates were observed.

PALP 6 mm thick were installed on the sheet screens of power drums and transfer hoppers on belt conveyors for feeding clay into a continuous grinding mill at Ceramic Ware Factory Co. (Ekaterinburg). Before installation of the plates, adhesion of material either caused a decrease in the output of the grinding section by 4 – 5 times or totally stopped it in the winter cold in transferring pelletized clay from the cold raw materials warehouse to the heated premises of the grinding section in condensation of water vapors on the surface of the clay lumps. The duration of manual cleaning of the equipment was from 5 to 8 h a day. After installing the plates, the down time decreased, and the necessity of manually cleaning the equipment was eliminated. During its operation, 28,900 tons of clay pelletized to a pellet size of 20 – 60 mm, with a moisture content of 8 – 19% in the presence of the effect of winter "wetting" of the pellets, passed through the process equipment. The throughput of the units was not only restored to the nominal values, but was also increased by 1.4 times on average. On visual inspection of the surfaces of the PALP in contact with the charged material, no wear was noted.

The results of the pilot-industrial tests of PALP indicate that it is expedient to line the working surfaces of both intermittently and continuously operating weighing hopper batchers; hoppers for temporary storage and subsequent passage of raw materials; and transfer hoppers on conveyors with PALP OE 6 and 8 mm thick to ensure a defined error of batching water of ± 2% and an error for fillers of ± 3% and to improve the quality of the batch at glass and ceramics factories. Vibrators with electric driers and auxiliary equipment — transformers, current frequency transducers, plug and socket connections, etc., are eliminated.

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